

1           determining, on the basis of the positions of the shapes relative to the  
2 reference object, those shapes that have no chance of intersecting the ray, and  
3 those remaining shapes that may intersect the ray.

4

5           2.       The method of claim 1 further comprising using a predetermined  
6 algorithm to determine which one of those remaining shapes intersects the ray.

7

8           3.       The method of claim 1, wherein the collection of shapes comprises  
9 at least one polygonal shape.

10

11          4.       The method of claim 1, wherein the collection of shapes comprises a  
12 plurality of polygonal shapes.

13

14          5.       The method of claim 1, wherein the collection of shapes comprises  
15 at least one triangle.

16

17          6.       The method of claim 1, wherein the collection of shapes comprises a  
18 plurality of triangles.

19

20          7.       The method of claim 1, wherein the collection of shapes comprises a  
21 triangle mesh.

22

23          8.       The method of claim 1, wherein the collection of shapes comprises a  
24 triangle strip.

1       9.    The method of claim 1, wherein the collection of shapes comprises a  
2       triangle fan.

3

4       10.   The method of claim 1, wherein said reference object comprises at  
5       least one plane.

6

7       11.   The method of claim 1, wherein said reference object comprises a  
8       plurality of planes each of which contain the ray.

9

10      12.   The method of claim 1, wherein said determining the positions of the  
11       shapes comprises determining positional aspects of sub-components of individual  
12       ones of the shapes to provide the characteristic data.

13

14      13.   The method of claim 12, wherein the individual shapes comprise  
15       polygons and the sub-components comprise vertices that define the polygons, said  
16       determining the positions of the shapes comprising computing the positions of the  
17       vertices relative to the reference object.

18

19      14.   The method of claim 13, wherein the reference object comprises a  
20       plane.

21

22      15.   The method of claim 14, wherein the plane is parallel to one of the  $x$ ,  
23        $y$ , and  $z$  axes.

1       16. In a computer graphic processing system in which a ray is cast  
2 toward an object represented by a collection of pre-determined shapes, a method  
3 for determining which of the shapes are intersected by the ray, the method  
4 comprising:

5           defining a collection of polygons that approximate an object, individual  
6 polygons having a plurality of vertices;

7           casting a ray toward the approximated object;

8           defining a reference object relative to the collection of polygons and that  
9 contains the cast ray;

10          pre-characterizing at least some vertices of at least some of the polygons to  
11 provide characteristic data that describes the vertices' positions relative to the  
12 reference object; and

13          using the characteristic data to ascertain the positions of the individual  
14 polygons relative to the reference object.

15  
16       17. The method of claim 16, wherein the collection of polygons  
17 approximate the surface of the object.

18  
19       18. The method of claim 16, wherein the individual polygons have a  
20 similar geometry.

21  
22       19. The method of claim 16, wherein the individual polygons comprise  
23 triangles.

1       20. The method of claim 16, wherein the collection of polygons has a  
2 plurality of faces and a plurality of vertices, said faces outnumbering said vertices.  
3

4       21. The method of claim 16, wherein at least two of said polygons share  
5 at least one side.  
6

7       22. The method of claim 16, wherein at least two of said polygons share  
8 at least one vertex.  
9

10       23. The method of claim 16, wherein none of said polygons share a  
11 vertex.  
12

13       24. The method of claim 16, wherein said using of the characteristic data  
14 comprises determining whether an individual polygon is in a sub-set of polygons  
15 that might be intersected by the ray.  
16

17       25. The method of claim 16, wherein said using of the characteristic data  
18 comprises determining whether an individual polygon is in a sub-set of polygons  
19 at least some of which straddle the reference object.  
20

21       26. The method of claim 16, wherein said using of the characteristic data  
22 comprises determining whether an individual polygon is in a sub-set of polygons  
23 at least some of which straddle the reference object, and further comprising  
24 evaluating the sub-set of polygons to determine which polygons are intersected by  
25 the ray.

1  
2 27. In a computer graphic processing system in which a ray is cast  
3 toward an object represented by a collection of pre-determined shapes, a method  
4 for determining which of the shapes are intersected by the ray, the method  
5 comprising:

6 defining a plurality of triangles that approximate an object, individual  
7 triangles having three vertices;

8 casting a ray toward the approximated object;

9 defining at least one plane relative to the approximated object to contain the  
10 ray;

11 pre-characterizing the vertices of the plurality of triangles to provide  
12 characteristic data that describes the positions of the vertices relative to said at  
13 least one plane; and

14 using the characteristic data to ascertain the positions of the individual  
15 triangles relative to said at least one plane.

16  
17 28. The method of claim 27, wherein said defining of said plurality of  
18 triangles comprises defining a triangle mesh.

19  
20 29. The method of claim 27, wherein said defining of said plurality of  
21 triangles comprises defining a triangle fan.

22  
23 30. The method of claim 27, wherein said defining of said plurality of  
24 triangles comprises defining a triangle strip.

1       31. The method of claim 27, wherein said using of the characteristic data  
2 comprises determining whether a particular individual triangle has a chance of  
3 being intersected by the ray.

4

5       32. The method of claim 27, wherein said using of the characteristic data  
6 comprises determining whether a particular individual triangle straddles said at  
7 least one plane.

8

9       33. The method of claim 27, wherein said using of the characteristic data  
10 comprises defining a sub-set of triangles at least some of which straddle the plane,  
11 and further comprising evaluating the sub-set of triangles to ascertain which  
12 triangles are intersected by the ray.

13

14       34. The method of claim 27, wherein none of the triangles share any  
15 vertices.

16

17       35. The method of claim 27, wherein all of the triangles share at least  
18 one vertex with another of the triangles.

19

20       36. The method of claim 27, wherein said defining of said at least one  
21 plane comprises defining a plane to be parallel to one of the  $x$ ,  $y$ , or  $z$  axes.

22

23       37. In a computer graphic processing system in which a ray is cast  
24 toward an object represented by a collection of pre-determined polygons, a method

1 for determining which of the polygons are intersected by the ray, the method  
2 comprising:

3 defining a sub-set of polygons from a collection of polygons that  
4 approximate an object by determining which polygons have vertices that satisfy a  
5 predefined relationship relative to a reference object; and

6 evaluating the sub-set of polygons to ascertain which of the polygons is  
7 intersected by a cast ray.

8  
9 38. The method of claim 37, wherein the reference object comprises a  
10 plane.

11  
12 39. The method of claim 37, wherein the reference object comprises  
13 multiple planes.

14  
15 40. The method of claim 37, wherein the reference object comprises a  
16 plane, and said determining comprises determining which polygons straddle the  
17 plane.

18  
19 41. One or more computer-readable media having computer-readable  
20 instructions thereon which, when executed by a computer, implement the method  
21 of claim 37.

22  
23 42. A programmable computer having a memory and a processor, the  
24 memory containing software code which causes the processor to execute the  
25 method of claim 37.

1  
2       43. A computer graphic processing system comprising a programmable  
3 computer programmed with computer-readable instructions which, when executed  
4 by the programmable computer, implement the following method:

5           defining a plurality of polygons that approximate an object, individual  
6 polygons having a plurality of vertices;

7           casting a ray toward the approximated object;

8           defining at least one plane relative to the approximated object to contain the  
9 ray;

10           pre-characterizing the vertices of the plurality of polygons to provide  
11 characteristic data that describes the positions of the vertices relative to said at  
12 least one plane;

13           using the characteristic data to ascertain the positions of the individual  
14 polygons relative to said at least one plane;

15           determining which of the individual polygons might be intersected by the  
16 ray, based upon their ascertained positions, to provide a sub-set of polygons; and

17           evaluating the sub-set of polygons to ascertain which of the polygons are  
18 intersected by the ray.

19  
20       44. The computer graphic processing system of claim 43, wherein said  
21 defining of the plurality of polygons comprises defining a polygon mesh.

22  
23       45. The computer graphic processing system of claim 43, wherein said  
24 defining of the plurality of polygons comprises defining a polygon fan.

1       46. The computer graphic processing system of claim 43, wherein said  
2 defining of the plurality of polygons comprises defining a polygon strip.  
3  
4

5       47. The computer graphic processing system of claim 43, wherein said  
6 defining of said at least one plane comprises defining said plane to be parallel to  
7 one of the x, y, and z axes.  
8  
9

10      48. One or more computer-readable media having computer-readable  
11 instructions thereon which, when executed by a computer graphic processing  
12 system, implement the following method:  
13  
14

15       defining a plurality of triangles that approximate an object, individual  
16 triangles having three vertices;  
17  
18

19       casting a ray toward the approximated object;  
20  
21

22       defining at least one plane relative to the approximated object to contain the  
23 ray;  
24  
25

26       pre-characterizing the vertices of the plurality of triangles to provide  
27 characteristic data that describes the positions of the vertices relative to said at  
28 least one plane;  
29  
30

31       using the characteristic data to ascertain the positions of the individual  
32 triangles relative to said at least one plane;  
33  
34

35       determining which of the individual triangles might be intersected by the  
36 ray, based upon their ascertained positions, to provide a sub-set of triangles; and  
37  
38

39       evaluating the sub-set of triangles to ascertain which of the triangles are  
40 intersected by the ray.  
41  
42

1       49. The one or more computer-readable media of claim 48, wherein said  
2 defining of the plurality of triangles comprises defining one of a triangle mesh, a  
3 triangle strip, and a triangle fan.

4

5       50. A computer graphic processing system comprising:  
6           a processor;  
7           memory; and  
8           software code stored in the memory that causes the processor to implement  
9 a ray-intersection algorithm which:  
10           casts a ray at a collection of shapes that approximate an object;  
11           defines a reference object that contains the ray;  
12           pre-characterizes aspects of individual ones of the shapes of the collection  
13 to provide characteristic data; and  
14           uses the characteristic data to ascertain the position of the shapes of the  
15 collection of shapes relative to the reference object.

16

17       51. The computer graphic processing system of claim 50, wherein the  
18 ray intersection algorithm casts a ray at a collection of polygons, each of which  
19 have similar geometries.

20

21       52. The computer graphic processing system of claim 50, wherein the  
22 ray intersection algorithm casts a ray at a collection of triangles.

23

24       53. The computer graphic processing system of claim 52, wherein the  
25 collection of triangles defines a triangle mesh.

1

2       54. The computer graphic processing system of claim 50, wherein the  
3 ray intersection algorithm pre-characterizes aspects of the shapes by computing  
4 positions of various sub-components of the shapes relative to the reference object.

5

6       55. The computer graphic processing system of claim 54, wherein the  
7 reference object comprises at least one plane.

8

9       56. The computer graphic processing system of claim 55, wherein the  
10 shapes comprise polygons and the sub-components comprise vertices of the  
11 polygons.

12

13

14

15

16

17

18

19

20

21

22

23

24

25